PCT/AU2004/001273

AUSTRALIA

REC'D 05 OCT 2004

WIPO PCT

Patent Office
Canberra

PRIORITY DOCUMENT

SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

I, JULIE BILLINGSLEY, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2003905066 for a patent by ICT SYSTEMS PTY LTD as filed on 17 September 2003.

COMMONWEALTH OF AUSTRALIA
AUSTRALIA
PATENT OFFICE

WITNESS my hand this
Twenty-ninth day of September 2004

J. Billingsley

JULIE BILLINGSLEY
TEAM LEADER EXAMINATION
SUPPORT AND SALES

17 September, 2003

Regulation 3.2

ICT SYSTEMS PTY LTD

AUSTRALIA

Patents Act 1990

PROVISIONAL SPECIFICATION

for the invention entitled:

"Location and Messaging System"

The invention is described in the following statement:

Location and Messaging System

Field of the Invention

The present invention relates to a location and messaging systems in a facility. Although the invention will be described in relation to its application to a passenger terminal facility such as an airport, it is equally applicable to a range of other facilities where the location of a person or object is required or where messaging to the person or object is necessary. For example, the invention is applicable to hospital facilities where monitoring of medical staff and patients location and the selective dissemination of messages to staff can significantly improve efficiency.

Background

Location systems for locating a person within a facility are known. Often the person carries around an identification transponder which sends a signal or signals to a set of receivers which in turn send a signal to a central processing unit. Usually the signal from the transponder to the receivers is an identification signal and the signal from the receivers to the central processing unit includes the identification signal from the transponder and signal strength. The central processing unit is then able to determine the location of the transponder, and consequently the person in the facility.

Messaging systems are known such as Short Messaging Service and Paging Services. These often send messages from a base station to a receiver which displays or otherwise communicates a message.

A system that includes both a messaging and location system is known from US Patent No 5,543,797. A monitoring assembly and system monitors the location of mobile objects within a structure. The assembly includes a plurality of transponder means, transceivers located in spaced areas about the monitored structure and a

central controller that monitors the location of each transponder. The transponder transmits a signal in response to a signal, containing the transponder's ID, from a transceiver. Each transceiver is connected to the controller in parallel and sends the signal containing the transponder's ID and all transceivers are able to receive the signal from the transponder. The transceivers collect signal strength and other data and forward this to the central controller. The controller stores the values in a memory so that the location of the transponder is known. The transponder includes audio means for audibly communicating with the person.

For large systems, for example in a multi story building, large amounts of cabling is required to connect the central computer to the receivers. One solution is to send the signal from the receivers to the central computer wirelessly, however in large applications the power required to transmit the signal is large and may be unsafe. Additionally, a relatively large amount of bandwidth can be required to communicate simultaneously with a large number of receivers

It is therefore desirable to provide a location and/or messaging system in which the signals are wirelessly transmitted whilst being transmitted at low power levels.

Summary of the Invention

Accordingly, the present invention is a communication system for a locating and messaging system in a facility, including a plurality of base stations each having a known location, and a central controller. The base stations being grouped by a plurality of micro-cells which are small networks of base stations within a relatively small area, when compared to the facility, and include at least two base stations. Each micro-cell includes at least one base station that is a member of another micro-cell. At least one micro-cell is able to communicate with a central controller.

Preferably each micro-cell includes at least two base stations that are members of other micro-cells.

Preferably, the micro-cells include between two and six base stations and are formed by the base stations periodically transmitting a message including its unique identification number and its transmitting power, each base station maintaining a list of signals received from other base stations and the signal strength, expressed as a fraction of the transmission power, which is also transmitted with the unique identification number and transmitting power, and altering its own signal power such that there is minimal overlap of base stations between micro-cells.

In another aspect, the present invention is a method of communication over a communication system of a facility including a plurality of base stations each having a known location, the base stations being grouped by a plurality of micro-cells, and a central controller. The micro-cells are small networks of base stations within a relatively small area, when compared to the facility, and include at least two base stations. Each micro-cell includes at least one base station that is a member of another micro-cell. At least one micro-cell is able to communicate with a central controller which controls the information communication throughout the facility. Messages are transmitted over the communication system by a base station transmitting the message to all base stations within a micro-cell to which it belongs, and at least one other base station within the micro-cell transmitting the message to the base stations within another micro-cell to which the other base station belongs.

Preferably, the micro-cells include between two and six base stations and are formed by the base stations periodically transmitting a message including its unique identification number and its transmitting power, each base station maintaining a list of signals received from other base stations and the signal strength, expressed as a fraction of the transmission power, which is also transmitted with the unique identification number and transmitting power, and altering its own signal power such that there is minimal overlap of base stations

between micro-cells.

In another aspect the present invention provides a system for locating and messaging with a mobile device including a plurality of mobile devices, a plurality of base stations and a central computer. The mobile devices include a transceiver for receiving and sending signals, a display device for displaying messages, a power source and at least one user interface for accepting an input from a person. The base stations include a transceiver for sending signals and messages to the mobile devices and to other base stations. At least one base station is also able to send signals and messages to the central computer. The base stations are arranged in micro-cells such that each micro-cell includes at least one base station that is also a member of another micro-cell. The central computer includes a database of locations of the base stations and a database of which base stations have received a reply signal from the mobile device.

Preferably, the micro-cells include between two and six base stations and are formed by the base stations periodically transmitting a message including its unique identification number and its transmitting power, each base station maintaining a list of signals received from other base stations and the signal strength, expressed as a fraction of the transmission power, which is also transmitted with the unique identification number and transmitting power, and altering its own signal power such that there is minimal overlap of base stations between micro-cells.

For convenience the application has coined the generic term Local Area Wireless Security (LAWS) network to describe the technology of the invention.

The invention will now be described in relation to locating passengers in an airport passenger terminal facility and providing messages with reference to the accompanying drawings.

Brief Description of the Drawings

Figure 1 is a schematic flow chart showing the steps, information flow and some of the components used between booking a ticket and check-in for an airline passenger departing from an airport utilising the communication system according to this invention;

Figure 2 is a flow chart similar to Figure 1 showing the steps, information flow and some of the components used between check-in and boarding of an aircraft; and

Figure 3 is a schematic drawing of base stations and area of coverage in a facility using the communication system according to this invention.

Description of the Preferred Embodiment

System Overview

The communication system of this invention in its application to an airport passenger facility involves the use of radio frequency tracking device (RFTD) that is issued to each passenger when they check in to a scheduled flight departing from that airport. Each RFTD issued uniquely identifies the associated passenger. The communication system of this invention allows the location of an FTD to be tracked throughout the terminal facility and allows messages relevant to flight details to be passed to the RFTD for the information of the passenger. Figure 1 is a schematic flow chart showing the steps involved and information flow between the time a passenger makes an air travel booking or purchases a ticket and subsequently arrives at the airport. The first part of the flow chart shows the standard steps involved in a passenger making a booking or purchasing a ticket. The passenger makes a booking and the airline data is retrieved by a travel agent or sales representative and transmitted over the existing International Aviation Transport Association (IATA) networks to the airline booking system. Check-in

procedure at an airport proceeds in the normal way using the airline's existing facilities. The passenger data is displayed at the airline operator's terminal and verified with the passenger. The airline computer system will have previously been updated with flight data retrieved and confirmed from flight information databases. The passenger identity is confirmed and the usual baggage data recorded and seat allocation steps proceed. This information is downloaded through an interface to both the RFTD that will be issued to the passenger and to the communication system server. The transfer of the data from the airline computer activates the RFTD that is given to the passenger and sends a request to the communication system server to admit a new passenger identification corresponding to the RFTD to the system. The server operates through a network control which communicates with the RFTD via the network.

Figure 2 schematically shows the path of an RFTD designated RFTD 1 through the communication system from check-in to a boarding gate where the RFTD is returned. The RFTD units are re-chargeable battery powered transceiver with onboard memory, RFID chip, LCD display, an infra red port covering IR transmit and receive diodes, a user interface in the form of a button to scroll through messages and data displayed. When not in use the RFTD is stored and transported in a secure transport case enclosing a number of cradles for RFTDs. When placed in these cradles the RFTD battery is inductively recharged and the IR port is enabled as a data connection and for diagnostic processes. A number of light emitting diodes can be provided for diagnostic and communication purposes. The communication network is made up of a series of base stations numbered in Figure 2 as 0-11. The operation of the network will be described in greater detail below. In overview each base station is a low power limited range transceiver. Each base station is only able to transmit or receive from closely adjacent base stations. This creates a network of smaller overlapping networks or micro-cells as will be described in further detail below. At least one of the base stations is in communication with the network server which logs all the information received from at least one of the base stations.

The base stations regularly transmit their identity and other information. The RFTD devices always receive but only transmit when they first "hear" a particular base station or when they cease to hear a particular base station. These reports are transmitted to the network server in the manner described in further detail below.

Should an RFTD move outside the range of the network, for example by leaving the airport, a perimeter alert will be sent to the network server from the perimeter base station. The time and place at which the RFTD left the network will be communicated to the airline on which the passenger was scheduled to travel.

It will be apparent that through this system appropriate messages can be provided to a passenger via the RFTD. For example messages about delayed flights can be transmitted or instructions to urgently proceed to the gate issued. Additionally, the system can issue messages that guide a passenger to a destination by providing reference to physical features in the building and signage.

The airline staff can access the network server to identify all RFTD's issued in relation to a particular flight. This enables the messages to be sent by airline staff to individual passengers or groups of passengers. The server is also able to provide a display of the floor plan of the airport showing location of RFTD's issued on a particular flight. Various menus are provided for calling flights and sending messages to passengers and identifying distances and estimates of time passengers are from a particular point. If a passenger fails to board an aircraft their location can be determined and appropriate action taken.

At the boarding gate the RFTD is returned to airline staff and its return is logged to the network server.

The detailed operation of the communication system and operation of the base

stations and mobile RFTD units is described below.

Base Stations

All base stations are identical in construction and run identical software, save for a unique ID encoded within the software.

Base stations are deployed in enclosed spaces (rooms) to provide wireless coverage of the whole area of operation in the facility. The precise location of the (physically static) base station is known at the time of deployment in terms of an Easting/Northing coordinate pair (this is derived from a site plan of the installation in terms of some X/Y metric grid).

Given the complex topology within which base stations are deployed in any given application, the characteristics of Radio Frequency transmission and performance cannot be predicted with any level of certainty in advance of deployment. However, experiments confirm a high level of RF transparency within and between enclosed spaces, within a typical operating environment.

Base stations have a maximum transmitting range of approximately 50-100 metres depending on the physical layout of the environment. Variations in transmitting range are evident from unit-to-unit (because of minor variations in the manufacture of electrical components) and at different times of the day (because of atmospheric and electromagnetic variations.

The power with which a base station transmits (and hence the range of that transmission) can be dynamically varied under software control. The base stations are also able to make a measurement of received signal strength from either another base station or mobile unit (RFTD).

The devices have a relatively low bandwith (72,000 bits/sec). This allows short

message transactions with minimal protocol overhead in order to operate efficiently a synchronised set of base stations in a network, to enable maximum information flow.

Radio Frequency Trackable Devices (RFTD)

The RFTDs are rechargeable battery powered transceivers with a unique ID. The ID of each mobile unit is recorded on the network server against the passenger name, flight details and other information at the time of issue of the mobile unit. The RFTD includes onboard memory and a processor to run software associated with its operation. The RFTD detects base station transmissions and determines whether it has previously heard that base station within a determined previous time interval. When the RFTD detects a new base station or fails to re-detect a previously heard base station within the selected period it transmits a message with the ID of the base station and its estimated distance to the nearest visible base station.

Operation

Referring to Figure 3, the communication system and related location and messaging systems are formed around the main concept of having a plurality of micro-cells which are linked together with the minimum amount of overlap. This can be achieved by only having one base station within a first micro-cell being also in a second micro-cell. This means that there are no multiple connections between micro-cells. The base stations 1-10 are located throughout the facility and have adjustable power levels. The micro-cells MC1, MC2, MC3, MC4, MC5 and MC6 are formed to enable quick communication throughout the system.

For example, if a message was to be sent to base station 10 in MC6 from base station 0, base station 0 would transmit the message to its micro-cell 1 (MC1). Base station 3 would then transmit the message to its other micro-cells MC2 and

MC3.

Base Station 6, a member of MC3, MC4 and MC5 then ripples the message to all base stations in MC4 and MC5. At this stage only base stations 10 and 11 have not received the message. Base station 9, a member of MC4 and MC6 would then transmit the message to the other members of MC6 including base station 10.

The system of base stations will configure themselves into set of a managed interconnected micro-cells under software control, which can dynamically change in response to operating conditions.

In one embodiment of the invention, the communication system is enabled by a software protocol in the base stations, which in turn governs the formation of micro-cells. Each base station will periodically, every few seconds, transmit a message containing its unique ID and its transmitting power. Each base station will maintain a list of the other base stations it can "hear", together with the signal strength observed from those base stations. This is expressed as a fraction of the transmission power, eg base station A transmits at 75%, base station B receives the signal at 50%, thus Effective Signal Strength (ESS) is 0.5/0.75 = 0.66.

When each base station transmits its unique ID it will also transmit the list of base stations it can see. Thus, each base station can dynamically estimate the membership of its local micro-cell, as well as the extent of overlap with adjacent micro-cells. Thus, if a base station can see another base station, which in turn can see a third base station which is "invisible" to the first base station, then the first base station knows there is an adjacent micro-cell of which the third base station is a member. This knowledge is essential to the "ripple protocol": if a base station receives a message from another base station and both base stations can see the same set of base stations, then there is no need to further propagate that message. However, if the receiving base station can see base stations not seen

by the first sender, then the message must be relayed.
Initially, at power-up, base stations will transmit at minimum power, gradually increasing. As messages are received, from adjacent base stations, each base station will reduce its power until the characteristics of local micro-cells meet the required operation of minimal overlap. From then on, power will be varied to maintain the required micro-cell characteristics.

In this embodiment micro-cells will not necessarily have fixed membership. Transient changes may be expected because of varying operating conditions such as humidity and the amount of absorption of the signal by the environmental changes. The overall coverage of the system will be self-correcting, in that holes created by failure of hardware can be dynamically accommodated for.

In the system, most base stations are likely to be to be remote from, or out of range, of the central controller. The central controller holds all central data on flights/passengers and is the interface between client users at check-in and departure applications, the communication system and mobile units. It will be necessary to receive and transmit messages to and from the remote base stations.

A message is conveyed across the system by each micro-cell sending the message to adjacent micro-cells, causing a ripple effect. As each base station in the micro-cell receives the message when transmitted, the message is retransmitted as shown in Figure 3.

In operation as a locating and messaging system, RFTDs will enter and leave micro-cells. The RFTD will hear the base stations transmission declaring its ID as part of the micro-cell management cycle. The RFTD will maintain a list of 'visible' base stations. When the RFTD detects it has heard a new base station, or lost a previously visible base station, it will inform a visible base station of that event by passing a message with the unique ID of the base station (and its estimated

distance – zero in the case of a lost base station) which generated the event. The base station will send this message to the central controller. The location of the micro-cells allows a central server to estimate the physical location of the RFTD, together with the estimated distance to the RFTD.

At any time, the central controller knows for any given RFTD which base stations are visible and their estimated distance from the RFTD. Thus the central controller can estimate by simple triangulation the location of a RFTD, by reference to each base station location and its estimated distance from the RFTD.

The majority of base stations are likely to be out of range of the host server - ie 'remote'. The host server holds all central data on flights/passengers, and is the interface between client users at check-in and departure applications, and the network and RFTD. It will be necessary for the host server to transmit messages to, and receive messages from, the 'remote' base stations.

To conserve bandwidth, the message need not be transmitted individually to each base station in turn - since any base station within a micro-cell will receive any message transmitted by any other member of its micro-cell. The message is conveyed across the interconnecting set of micro-cells, to its destination, with the minimum number of re-transmissions (hops).

Distance Determination

Empirical studies of the devices operating in a range of typical environments (for example, outdoors, indoors, indoors in closed spaces) allow the tabulation of received signal strength against the distance between units, for different transmitting signal strengths. Thus, when a unit receives a signal from another unit, transmitted at a known strength, it can estimate the its distance from that unit based on the received signal strength of that message. The relationship between ESS, transmitted signal strength, received signal strength and distance apart is

entirely empirical based on the actual electronic performance of the developed devices.

Ripple Protocol for Relaying Messages Across the Network

The progress of a message being relayed across the network may be pictured as the waves of a ripple progressing across a pond. Each base station maintains a list of "visible" base stations that form the local "micro-cell". Appended to each ID of the 'visible' members of the micro-cell is a list all other base stations which that ID can see. Thus BS0 can see 1, and 3. BS3 can see 0, 1, 2, 4, 5 and 6. BS1's record of the ID of BS3 notes that 3 can also see 2, 4, 5 and 6.

When a message is received by a member of the micro-cell, that member will be able to determine which other members of its micro-cell will have received that message (those which overlap with the sending base station). Thus, the receiving base station can deduce which other base station is the best candidate to relay a message to an adjacent micro-cell. Note that when relaying the message to the chosen base station, all members of the current micro-cell receive the message as well.

If the message is being addressed to an individual base station which is a member of the current micro-cell, intended for a local RFTD, then the message can simply be sent to that specific base station, rather than be relayed. If a message is being broadcast to all RFTDs (eg for all passengers on a particular flight) then the receiving base station, by relaying the message on to an adjacent micro-cell, automatically ensures that all base stations (and adjacent RFTDs) within the micro-cell will have received that message.

Thus when the host server wishes to transmit a message to a remote RFTD, it is necessary only to transmit the message to the base station "closest" to the host server which will then begin the process of relaying the message. The message will be relayed to the base station nearest the RFTD, since if that base station

hears the message, so will the RFTD. When a RFTD wishes to send a message to the server then it simply has to send that message to its nearest base station, which then relays the message across the network, eventually to the host server.

Thus, messages are not sent to RFTD's directly, rather the population of base stations all receive the message, and therefore any RFTD within the network defined by the base station population receive the message. The logic within the software of the individual RFTD determines what action, if any, an individual RFTD will take to any given message.

Some base stations will have direct ethernet connectivity (connected via cable or by wireless ethernet) to the host server. In the case of these base stations, they will not relay messages - rather they will send the message directly to the host server, and receive a message directly from the host server. The presence/absence of direct ethernet connectivity will depend on the scale and the physical environment within which any given application is deployed.

<u>Message Structure</u>

It is necessary to transmit messages of minimal length to make best use of the available bandwith; thus to ensure maximum information flow through the network each message should carry the minimal protocol overhead necessary to enable its transmission and delivery.

The following terms are defined:

Message Length (1 character) the total length of the message
Message Type (1 character) the type of the message (see below)
Sender ID (4 [8-bit] characters - all devices will have a unique 32bit ID generated at manufacture - approx 4billion permutations);
Initiator ID (4 characters) the device creating the message

Addressee ID (6 characters) - an individual RFTD or a flight number.
Message Number (1 character) a sequential count 0-15 maintained individually by each mobile unit; the count is increased for each successive message that the unit initiates - see below.
Hop Count (1 character) - see below. NB not required for A messages.
Checksum (2 character) - an arithmetic computation over the content of the message (all characters exclude the checksum itself) which can be re-computed by the recipient to check that the message content is not corrupt.

The hop count is the number of times a message is relayed before it expires. This ensures that a message will not continue circulating indefinitely. The value of hop count will be determined empirically when the initial network is deployed. Larger networks of base stations will require larger values, since a message must be relayed through more micro-cells to reach one end of the network from another. Each time the message is relayed the hop count is decreased by one until it reaches zero at which point no further relay is undertaken.

In addition, each base station will maintain a transient list of initiator Ids and message number of received messages. If a received message matches an entry on the list then it is not relayed. This list will not cover all possible RFTDs, since its purpose is only to monitor messages currently "live". This, plus the hop count above, will ensure the minimum number of re-transmissions.

The message vocabulary will consist of the following :

<u>A - Ping From A Base Station</u>

All base stations periodically output a ping. This allows other units to maintain a list of local units in view.

Field	Chars	Comment
Message Length	1	
Message Type	1	"A"
Sender ID	4	
Visible Base Station ID	4	
Check Sum	2	

Base station data repeated in the packet according to the number visible. Ping messages are not relayed beyond the immediate micro-cell.

B - Mobile Tells Base Station About Change To Bases

Only sent when the mobile detects a change to its visible set.

Field	Chars	Comment
Message Length	1	
Message Type	1	"B"
Sender ID	4	The RFTD or base relaying this message
Hop Count	1	
Message number	1	
Initiator ID	4	
Base Station ESS	4	1 to 255 for addition; 0 for delete
Check Sum	2	

The mobile units may be programmed to report when ESS changes by some critical value, to assist in tracking the mobile. Further it may be desirable to be able to set the critical reporting values dynamically by a message from the host server to a RFTD, so as to enable more frequent reporting from one or more mobiles under scrutiny. The host server will have a variety of other queries to the

population of mobile units that will interrogate sets of the mobile population or individual units to change mobile behavior and extract information from them.

C - Message For Mobile LCD

Initiated by the client/host server (PC applications), relayed across the network as required.

Field	*Chars*	*Comment*
Message Length	1	
Message Type	1	"C"
Sender ID	4	
Hop Count	1	
Message number	1	
Addressee ID	6	
Display Type	1	=1 for free text =2 for msg type 2 ..etc
Message	N	For free text msg only
Check Sum	2	

D - Set Passenger Details

Field	*Chars*	*Comment*
Message Length	1	
Message Type	1	"D"
Sender ID	4	
Hop Count	1	
Message number	1	
Addressee ID	4	
Flight	6	
Flight Time	4	Format 0930

Gate	4	
Baggage	1	Number of bags – but could be extended to baggage ID and type of accompanying luggage
Last Name	N	
Check Sum	2	

Note that a D message is sent at check in when the mobile unit is under immediate control; this message need not be rippled across the network. This depends on the configuration of the Power Box for the mobile units.

Once the details are stored in the mobile unit, the user may view the details through a simple key driven menu on the local RFTD - this has no impact on network traffic.

<u>E - Set Flight Time and Gate</u>

Field	***Chars***	***Comment***
Message Length	1	
Message Type	1	"E"
Sender ID	4	
Hop Count	1	
Message number	1	
Addressee ID	6	
Flight Time	4	Format 0930
Gate	4	
Check Sum	2	

Used to update flight information.

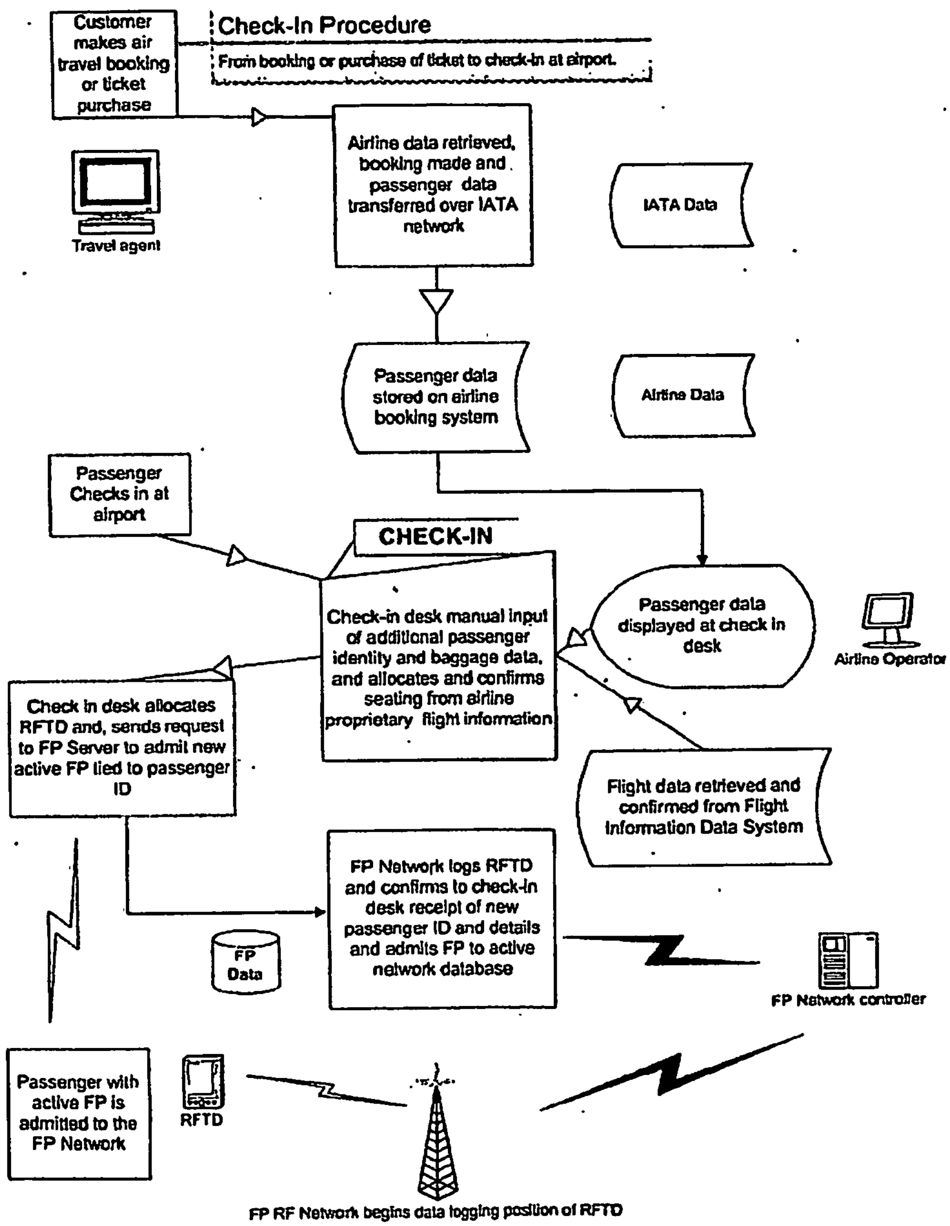
F - Set Operating Parameters in Mobile

Field	*Chars*	*Comment*
Message Length	1	
Message Type	1	"E"
Sender ID	4	
Hop Count	1	
Message number	1	
Addressee ID	6	
Value	2	Bit pattern
Check Sum	2	

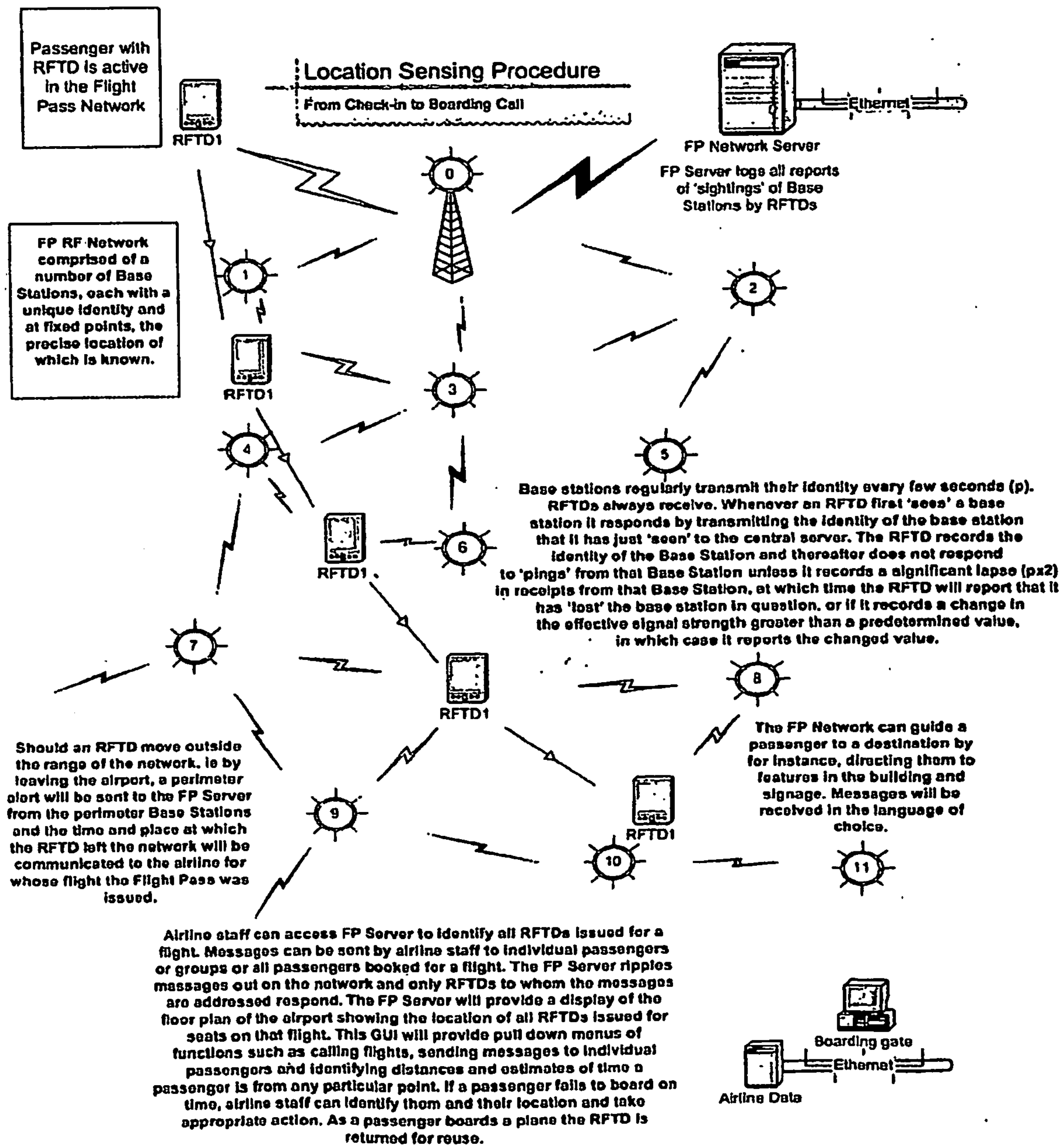
DATED this 17th day of September, 2003.

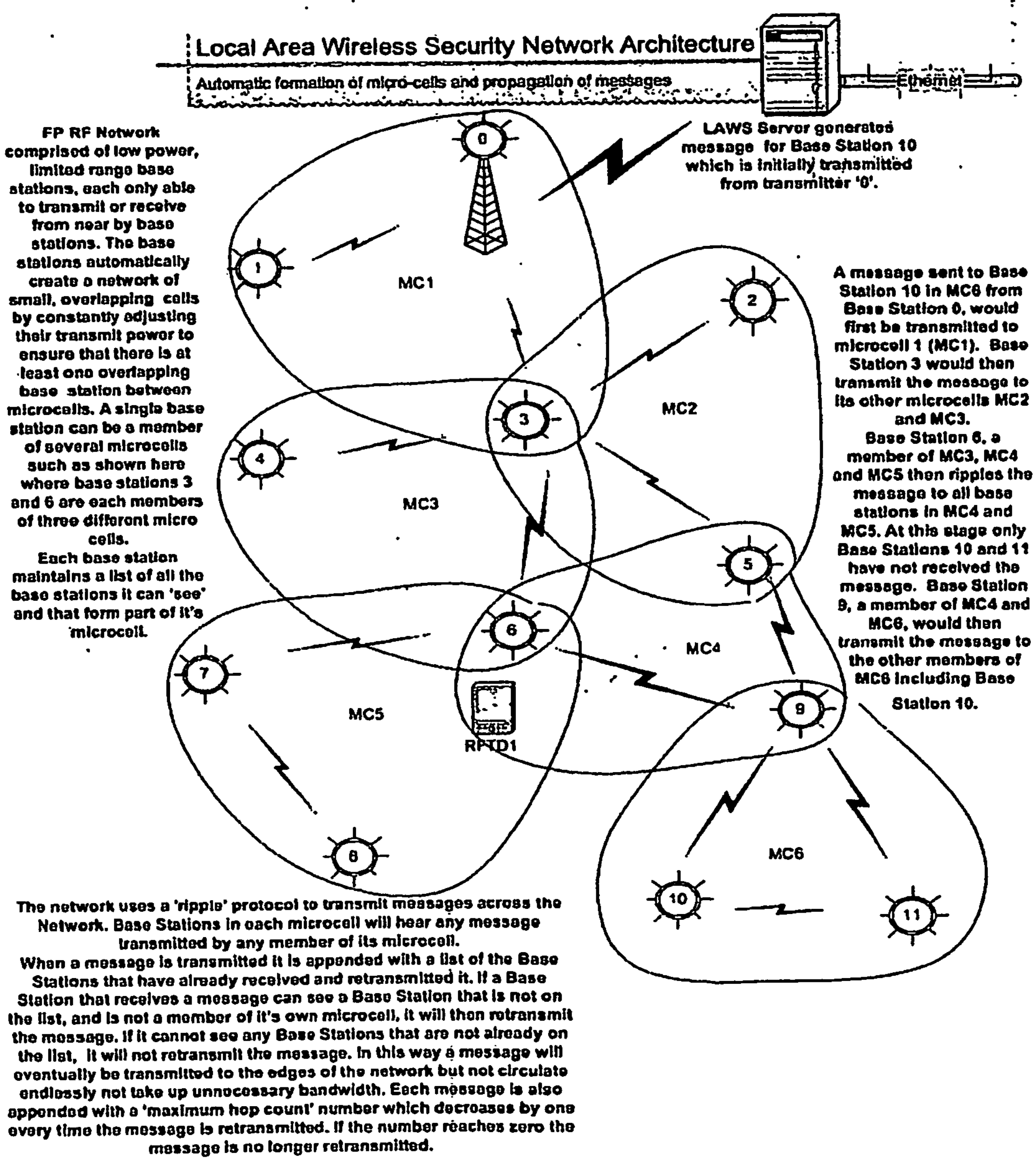
ICT SYSTEMS PTY LTD

by DAVIES COLLISON CAVE
Patent Attorneys for the Applicant



Customer makes air travel booking or ticket purchase
Check-In Procedure
From booking or purchase of ticket to check-in at airport.
Travel agent
Airline data retrieved, booking made and passenger data transferred over IATA network
IATA Data
Passenger data stored on airline booking system
Airline Data
Passenger Checks in at airport
CHECK-IN
Check-in desk manual input of additional passenger identity and baggage data, and allocates and confirms seating from airline proprietary flight information
Passenger data displayed at check in desk
Airline Operator
Check in desk allocates RFTD and, sends request to FP Server to admit new active FP tied to passenger ID
Flight data retrieved and confirmed from Flight Information Data System
FP Network logs RFTD and confirms to check-in desk receipt of new passenger ID and details and admits FP to active network database
FP Data
FP Network controller
Passenger with active FP is admitted to the FP Network
RFTD
FP RF Network begins data logging position of RFTD


Passenger with RFTD is active in the Flight Pass Network
RFTD1
Location Sensing Procedure
From Check-in to Boarding Call
FP Network Server
Ethernet
FP Server logs all reports of 'sightings' of Base Stations by RFTDs
FP RF Network comprised of a number of Base Stations, each with a unique identity and at fixed points, the precise location of which is known.
0
1
2
3
4
5
6
7
8
9
10
11
RFTD1
RFTD1
RFTD1
RFTD1
Base stations regularly transmit their identity every few seconds (p). RFTDs always receive. Whenever an RFTD first 'sees' a base station it responds by transmitting the identity of the base station that it has just 'seen' to the central server. The RFTD records the identity of the Base Station and thereafter does not respond to 'pings' from that Base Station unless it records a significant lapse (px2) in receipts from that Base Station, at which time the RFTD will report that it has 'lost' the base station in question, or if it records a change in the effective signal strength greater than a predetermined value, in which case it reports the changed value.
Should an RFTD move outside the range of the network, ie by leaving the airport, a perimeter alert will be sent to the FP Server from the perimeter Base Stations and the time and place at which the RFTD left the network will be communicated to the airline for whose flight the Flight Pass was issued.
The FP Network can guide a passenger to a destination by for instance, directing them to features in the building and signage. Messages will be received in the language of choice.
Airline staff can access FP Server to identify all RFTDs issued for a flight. Messages can be sent by airline staff to individual passengers or groups or all passengers booked for a flight. The FP Server ripples messages out on the network and only RFTDs to whom the messages are addressed respond. The FP Server will provide a display of the floor plan of the airport showing the location of all RFTDs issued for seats on that flight. This GUI will provide pull down menus of functions such as calling flights, sending messages to individual passengers and identifying distances and estimates of time a passenger is from any particular point. If a passenger fails to board on time, airline staff can identify them and their location and take appropriate action. As a passenger boards a plane the RFTD is returned for reuse.
Boarding gate
Ethernet
Airline Data


Local Area Wireless Security Network Architecture
Automatic formation of micro-cells and propagation of messages
Ethernet
FP RF Network comprised of low power, limited range base stations, each only able to transmit or receive from near by base stations. The base stations automatically create a network of small, overlapping cells by constantly adjusting their transmit power to ensure that there is at least one overlapping base station between microcells. A single base station can be a member of several microcells such as shown here where base stations 3 and 6 are each members of three different micro cells.
Each base station maintains a list of all the base stations it can 'see' and that form part of it's microcell.
LAWS Server generates message for Base Station 10 which is initially transmitted from transmitter '0'.
A message sent to Base Station 10 in MC6 from Base Station 0, would first be transmitted to microcell 1 (MC1). Base Station 3 would then transmit the message to its other microcells MC2 and MC3.
Base Station 6, a member of MC3, MC4 and MC5 then ripples the message to all base stations in MC4 and MC5. At this stage only Base Stations 10 and 11 have not received the message. Base Station 9, a member of MC4 and MC6, would then transmit the message to the other members of MC6 including Base Station 10.
0
1
2
3
4
5
6
7
8
9
10
11
MC1
MC2
MC3
MC4
MC5
MC6
RPTD1
The network uses a 'ripple' protocol to transmit messages across the Network. Base Stations in each microcell will hear any message transmitted by any member of its microcell.
When a message is transmitted it is appended with a list of the Base Stations that have already received and retransmitted it. If a Base Station that receives a message can see a Base Station that is not on the list, and is not a member of it's own microcell, it will then retransmit the message. If it cannot see any Base Stations that are not already on the list, it will not retransmit the message. In this way a message will eventually be transmitted to the edges of the network but not circulate endlessly not take up unnecessary bandwidth. Each message is also appended with a 'maximum hop count' number which decreases by one every time the message is retransmitted. If the number reaches zero the message is no longer retransmitted.